PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

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PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing *(day/month/year)*	17 JAN 2001

Applicant's or agent's file reference	**IMPORTANT NOTIFICATION**
360.07-PCT	

International application No.	International filing date *(day/month/year)*	Priority Date *(day/month/year)*
PCT/US98/25088	24 NOVEMBER 1998	21 AUGUST 1998

Applicant
SRI INTERNATIONAL

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	MARIANNE L. PADGETT B. Harden for
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
360.07-PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US98/25088	24 NOVEMBER 1998	21 AUGUST 1998
International Patent Classification (IPC) or national classification and IPC Please See Supplemental Sheet.		
Applicant SRI INTERNATIONAL		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets.

   [2] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I [X] Basis of the report
   - II [ ] Priority
   - III [ ] Non-establishment of report with regard to novelty, inventive step or industrial applicability
   - IV [ ] Lack of unity of invention
   - V [X] Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI [ ] Certain documents cited
   - VII [ ] Certain defects in the international application
   - VIII [X] Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17 MARCH 2000	14 DECEMBER 2000
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MARIANNE L. PADGETT Telephone No. (703) 308-2336

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US98/25088

I. Basis of the report

1. With regard to the elements of the international application:*

☐ the international application as originally filed

☒ the description:
pages (See Attached), as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☒ the claims:
pages (See Attached), as originally filed
pages _____, as amended (together with any statement) under Article 19
pages _____, filed with the demand
pages _____, filed with the letter of _____

☒ the drawings:
pages (See Attached), as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☒ the sequence listing part of the description:
pages (See Attached), as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the writen sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

☒ the description, pages None

☒ the claims, Nos. 21

☒ the drawings, sheets/~~fig~~ None

5. ☐ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** . . . . . .

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US98/25088

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	5, 9, 12-13, 15, 18-20	YES
	Claims	1-4, 6-8, 10-11, 14, 16-17	NO
Inventive Step (IS)	Claims	None	YES
	Claims	1-20	NO
Industrial Applicability (IA)	Claims	1-20	YES
	Claims	None	NO

2. citations and explanations (Rule 70.7)

Claims 1, 6-7, 10-11 and 17 lack novelty under PCT Article 33(2) as being anticipated by Baum et al (IBM Tech. Discl. Bull.)

Baum et al (IBM) teaches deposition of a solution which contains iron (III) oxalate and palladium (II) salts (but no particles, which is consistent with the claims as written) on a substrate via processes, such as spraying or spin coating, then using UV exposure to initiate the reduction reaction, which effects result on of the surface features. Thereafter, a further layer of Cu is deposited via an electroless plating bath. It is noted that since the claimed "desired pattern" has no requirements other than it is wanted, and it may be effected by use of spraying or a rotation plate, that Baum et al who desire to coat their substrate via spraying or spin coating (ie. rotating plate is used), before initiating their redox reaction, apply their solution in a pattern they desire.

Claim 9 lacks an inventive step under PCT Article 33(3) as being obvious over Baum et al (IBM). While Baum et al does not teach application of their solutions with a "jet", spray coating is generically taught and it would have been obvious to one of ordinary skill to use conventional spraying techniques, which include a jet of solution being sprayed onto a substrate.

Claims 1-3, 6-7, 10-11 and 18 lack novelty under PCT Article 33(2) as being anticipated by Baum et al (Photo selective circuitization ...).

Baum et al (Photo. circuitization.) is very similar to Baum et al (IBM) discussed above, but only exemplifies application of solutions by spin coating. In addition, it has extensive discussion of the techniques use in circuit construction, including mention of IC (integrated circuit) packaging in the introduction and conclusion, hence providing for integrated components, and ones that are "active" within the broad undefined possible meanings of the word. Also, this Baum et al article discusses particular details of their Cu coating procedure that include the use of formaldehyde as reducing agent, hence the Cu plating technique used in completing their component is also a redox reaction.

(Continued on Supplemental Sheet.)

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 2, 3, 7, 11 & 18 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because the claims 1-21 are indefinite for the following reason(s):

Use of relative terms that lack clear metes and bounds, either in the claim, the discription, or relevant cited prior art, are vague and indefinite. In claim 2, see "active" (how or with what or for what purpose is the component active?); in claim 3 "integrated" (with what is the component integrated?); in claim 7 "strong"; and in claim 11 "pure" (pure in what way? as in only metal deposits or there is only one metal present, etc. ...).

In claim 16, the relationship of the "successive layers" to any of the layers from claim 1 is not necessarily defined, hence unclear, because in line 7 "the layers" lacks proper antecedent basis, since the word used are not entirely consistant with the terms of independant claim 1.

In claim 18, it is unclear how "a desired pattern" (line 4) relates to "a desired pattern" in claim 1, as they lack either clear differentiation or an article showing antecedent basis. The pattern in lines 5-6 (and claim 19) is vague and indefinite, as it could refer to either.

In claim 1, it appears that "an electrical component" includes a surface plus 2 or more layers, hence lacking a clear description, claim 18 would have trouble connecting plural components that are all on different surfaces by the steps as claimed, especially with the pattern for making the components of claim 1, ambiguosly being the same as the pattern for connecting.

While not necessarily incorrect, it was noted that "desired pattern" provides for no particular effect, and one could desire an entire surface to be coated with solution as when one is spin coating if complete coverage is the pattern one desires. While applicant may desire the pattern to be related to the printing, such a relationship is not necessarily claimed.

In claims 1 & 17, it is noted that the percentage of particulates includes no particles being present, since "no more than" does not necessitate any positve amount, ie. includes zero.

The description is objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 5 because it fails to contain an adequate written description of applying the first solution using a rotation plate as it is using in claim 15. The description is inadequate because: no mention of using a rotating plate (or spin coating) was found in the description . Various

(Continued on Supplemental Sheet.)

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

CLASSIFICATION:
The International Patent Classification (IPC) and/or the National classification are as listed below:
IPC(7): B05D 3/00, 5/12; H01M 4/32, 4/34, 4/36, 4/44, 4/48, 4/54, 4/58
and US Cl.: 427/553, 115, 123, 125, 126.3, 126.4, 126.5, 126.6; 429/218, 220, 221, 223, 219, 188, 109, 193

I. BASIS OF REPORT:

This report has been drawn on the basis of the description,
page(s) 1-31, as originally filed.
page(s) None , filed with the demand.
and additional amendments:
None

This report has been drawn on the basis of the claims,
page(s) None, as originally filed.
page(s) None, as amended under Article 19.
page(s) None , filed with the demand.
and additional amendments:
pages 32-34, filed with letter of 27 October 2000.

This report has been drawn on the basis of the drawings,
page(s) 1-5, as originally filed.
page(s) None , filed with the demand.
and additional amendments:
None

This report has been drawn on the basis of the sequence listing part of the description:
page(s) NONE, as originally filed.
pages(s) NONE, filed with the demand.
and additional amendments:
NONE

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):

Claims 1, 6-7, 10-11, 14 and 17 lack novelty under PCT Article 33(2) as being anticipated by Lee et al.
Lee et al teaches reducing sites on a polymer substrate to create active surface sites, where selectivity may be obtained by use of a resist mask or a permanent resist on the polymeric film, then a electrolyte solution including; solubilized metal cations, such as Pd, Pt, Ag, Au, Cu, Co or Cu; an aprotic solvent; and a supporting electrolyte salt (no particles), is deposited (when a mask is used as taught only the desired pattern is deposited) and a redox reaction initiated. Lee et al can be said to complete their product with the addition of the inspection layer that is a redox deposition of a light reflective metal such as Pd.

Claims 1-4, 6-8, 10-11, 14 and 17 lack novelty under PCT Article 33(2) as being anticipated by Krause et al.
Krause et al teach patterned metallization of a surface, which is first masked, then activated via charge injection form a solution to form part of a redox couple. Subsequently, reduction of metal ions in a solution applied to the masked surface, applies that solution in a desired pattern that then undergoes reduction. Metals, such as Cu, Co, Au, Ni, etc., are taught to be deposited and the examples contain materials used in the redox couples that include acetates, nitrates (claim 18), etc. After the initial coating of the metal, further metal may be electroless plated, including by redox reaction processes. Taught uses discuss employment in integrated circuits, electronics, imaging, solar cells (a power source), photovoltaic devices, etc. Note the last two mentioned uses are types of power sources, and all have 'active' components deposited by the above technique.

Claims 1-3, 6-8, 10-11, 14 and 16-17 lack novelty under PCT Article 33(2) as being anticipated by Makkaev et al.
Makkaev et al teach a process for electrochemical metallization of dielectrics, for electrical uses inclusive of through holes and multilayers, printed circuit boards, etc. A masked substrate may be treated with a solution for electrochemical metallization, such as one containing a strong oxidizing agent such as Ca nitrate, and a strong reducing agent, such as

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

hypophosphate ions. The deposition reaction is initiated by heating, where processes that use IR or UV radiation are suggested. Therefore, the metal layer can be build up by successive electrochemical deposition. Ex. 1 in col 7, provides a teaching of multiple succeeding deposits, first one of Cu, then Ag.

Claims 18-20 lack an inventive step under PCT Article 33(3) as being obvious over Makkaev et al or Krause et al or Lee et al or Baum et al (IBM or Photo ..).

None of these references explicitly teach steps of forming one set of components by the redox technique than connecting them by the same technique, however they all teach use in general for the types of patterning required for such connectors, with Makkaev et al and Lee et al specifically mentioning producing multilayer/ multilevel products, hence in any of the references it would have been obvious to one ordinary skill to use the process of the above references for their intended purposes of metallization, whether it is a conductive component like an electrode, contact, layer of a capacitor, etc., or one of the wiring lines that connect such components on circuit boards and integrated circuits, because all of such feature would have been expected to be equally effectively metallized by the above techniques.

Claim 13 lacks an inventive step under PCT Article 33(3) as being obvious over Makkaev et al in view of Cooper et al.

Makkaev et al teaches heating of the deposited solutions to initiate the autocatalytic redox reaction, where the suggested heat sources are IR or UV radiation, but does not teach the claimed use of microwave radiation. In his background (col. 1, lines 17-24), Cooper et al teaches that catalytic reactors that typically use thermal energy to facilitate their chemical reactions, derive it from IR radiation, direct heating or even microwave absorption which manifest itself as an elevated temperature, therefore it would have been obvious to one of ordinary skill in the art to use microwave heating in Makkaev et al as an alternative to IR heating, as it is old and well known as shown by Cooper et al as an equivalent heat source for analogous types of chemical reactions, hence would have been expected to be equally effective.

Claims 1-7, 10-12 and 18-20 lack an inventive step under PCT Article 33(3) as being obvious over Youtsey et al.

Youtsey et al teach screen printing inks that upon firing in an oxidizing atmosphere, form conductive pigment coating. Use of these coatings is contemplated in microcircuits for active or passive components, where conductors, resistors, capacitors, etc., are mentioned. Note that as capacitors store energy, they are in essence a type of battery. Youtsey et al.'s ink (a solution) includes a non-noble conductive metal, such as Ni or Cu, plus at least one oxidizable material such as B or Al. After screen printing (produces a desired pattern), firing in an oxidizing atmosphere will cause a redox reaction with the oxidizable material, ie. Al goes to Al_2O_3, and will burn off the organic vehicle. While the deposit is conductive, it is not "pure" metal, but a large majority is metal (Ex. I or II would have above 80 to 90% conductive metal in the fired deposit), hence as it would have been obvious to one of ordinary skill in the art to minimize non-metal contributions in order to maximize conductivity, the resulting layer many approach "essentially pure metal". Youtsey et al do not teach metal oxide deposits as the whole composition of their deposited layer, however they do have minor amounts (less than 5%) of metal oxides is produced in their conductive deposits, and also teach an the background that silk screen patterned dielectrics can be deposited, and that control of composition and atmosphere effects degree of oxidation produced in the firing, therefore it would have been obvious to one of ordinary skill in the art that dielectric layers to complement the conductive layers, would have been usefully produced by like techniques, with suitable adjustments of composition and firing atmosphere for the desired end use.

While screen printing Youtsey et al's inks for successive layers or stages of the microcircuits are not discussed in the patent, ie. components, 'one additional layer', then the wiring deposits to connect components, it would have been obvious to one of ordinary skill in the art to apply the techniques of Youtsey et al in order to form as many individual layers as are needed to form both the individual components, such as capacitors which generally have at least a series of conductive/dielectric/ conductive layers; or to form the overall circuits which appropriately connect the various layers/components, because all would have been effectively so deposited, but could not all have been simultaneously deposited, expected for the simplest of circuits.

Claims 9 and 15 lack an inventive step under PCT Article 33(3) as being obvious over the prior art as applied in the immediately preceding paragraph and further in view of Cassat.

Youtsey et al only discuss screen printing of their inks, however Cassat teaches that deposition techniques of both screen printing and masking may be used for deposition of inks for circuit patterns. The examiner takes notice that use of rotating plates or jets (ie. spraying) when using masks are conventional and typical procedure to enable deposit of solutions, such as inks over the mask surface, and as such would have been obvious to one of ordinary skill in the art to employ for their usual purposes of even or uniform deposition, etc. Also, note that Cassat is cumulative to Youtsey et al, in that it confirms the above assertions concerning repeated depositing and patterning via inks for any of the conductive, resistive or insulating layers, as old and well known in the art.

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

---------- NEW CITATIONS ----------

US 4,079,156 A (YOUTSEY et al) 14 March 1978 (14/03/78), See abstract; col. 1, lines 10-32; col. 3, line 42 - col. 4, line 38; and

US 4,517,227. A (CASSAT) 14 May 1985 (14/05/85), See abstract; Col. 1, lines 7-32 and 54 - col. 2, line 16; Col. 6, lines 41-60; col. 7, lines 22-32; col. 8, line 35 - col. 9, line 10.

VIII. CERTAIN OBSERVATIONS ON THE APPLICATION (Continued):

application techniques were discuses on p. 15-18 under "Applying the solution ..." and these also related to patterning. Pages 14-15 under "Solubilizing ..." also discussed some of the same, but no discussion of a rotating plate was found, and none as it might relate to the amendment of "a desired pattern". Relative movement was generically mentioned (p. 15); a roll dispenser, but that rotates a cylinder not a plate; and on page 16 "the applicator need not translate ....., but may tilt or rotate....", however an applicator is not a plate. Therefore, the description fails to adequately describe the above claimed feature.

Claim 15 is objected to as lacking clarity under PCT Rule 66.2(a)(v) because practice of the claimed invention is not adequately described in writing, as required under PCT Rule 5.1(a)(iii), for the reasons set forth in the immediately preceding paragraph.

11. The method of claim 1 wherein the redox reaction results in the first layer consisting essentially of a pure metal.

12. The method of claim 1 wherein the redox reaction results in the first layer consisting essentially of a mixed metal oxide.

13. The method of claim 1 wherein initiating the redox reaction comprising radiating the applied solution with microwave radiation.

14. The method of claim 1 wherein completing the component comprises:
providing a second redox couple comprising a second oxidizer and a second reducer;
solubilizing at least one of the second oxidizer and the second reducer in a second solution;
depositing the second solution onto the first layer, and initiating a redox reaction in the second solution.

15. The method of claim 1 wherein the component comprises a battery, and applying comprises depositing the first solution using at least one of a stamp, a rotating plate, and a jet.

16. The method of claim 1 further comprising:
providing a second redox couple comprising a second oxidizer and a second reducer;
solubilizing at least one of the second oxidizer and the second reducer in a second solution;
depositing successive layers of the second solution, and initiating a redox reaction in the successive layers to produce a solid conductor that electrically couples at least two of the layers of the component that are mutually non-adjacent.

17. The method of any of claims 1 -16 wherein the first solution applied to the surface contains no more than 2% particulates by weight.

18. A method of printing an electronic circuit comprising:
printing a plurality of components according to one of the methods of claims 1 - 16; and

applying the first solution to the surface in a desired pattern that connects at least two of the plurality of components, and initiating the redox reaction in the desired pattern to produce a conductive trace between the at least two components.

19. The method of claim 17 wherein the pattern has a lateral resolution below 10 μm.

20. The method of claim 17 wherein the circuit includes a transistor, a power source, and a capacitor.

CLAIMS

What is claimed is:

1. A method of printing an electronic component comprising:
providing a surface;
providing a redox couple comprising an oxidizer and a reducer;
solubilizing at least one of the oxidizer and the reducer in a first solution that contains no more than 5% particulates by weight;
applying the first solution to the surface in a desired pattern to create a first layer;
initiating a redox reaction in the first layer; and
completing the component by adding at least one additional layer.

2. The method of claim 1 wherein the component comprises is an active component.

3. The method of claim 1 wherein the component comprises an integrated component.

4. The method of claim 1 wherein the component comprises a power source.

5. The method of claim 1 wherein the component comprises a battery.

6. The method of claim 1 wherein at least one of the oxidizer and the reducer comprises a metal containing compound, the metal selected from the list consisting of copper, iron, cobalt, tin, gold, silver, palladium, platinum, nickel, lithium, aluminum, and titanium.

7. The method of claim 1 wherein the oxidizer is a strong oxidizer and the reducer is a strong reducer.

8. The method of claim 1 wherein the redox couple includes a material selected from the list consisting of formate, nitrate, alkoxide nitrate, alkoxide perchlorate, acetate nitrate, acrylate nitrate.

9. The method of claim 1 wherein applying comprises depositing the first solution using at least one of a stamp and a jet.

10. The method of claim 1 wherein at least one of the first layer or the at least of one additional layers comprises an electrolyte.